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The time has come when we must explain the ways and means whereby teachers shall be able to make their large classes of children do independent observational and mental work,—in a word, scientific work,—and when this difficult task is accomplished we may rest assured that the power thus gained by the young will enable them to seek and find for themselves those original sources of knowledge on any given subject which are contained in many libraries. We may go even a step farther and make the logical prediction that this same power will enable some of them, perhaps, to add to the stock of absolute knowledge.

I desire to thank Mr. Kingsley for the expression of his views on other subjects concerning which naturalists are by no means agreed, and I write this reply only because the part of his review to which I have taken exception touches upon what Professor Hyatt and I consider a vital principle of science-teaching.

Respectfully yours, J. M. A.

General Notes.

GEOLOGY AND PALEONTOLOGY.

On a Collection of Fossil Birds from the Equus Beds of Oregon.[1]—Silver Lake is one of the alkaline lakes of Oregon, and lies somewhat to the southward of the middle part of the state, or, approximately speaking, in 43° .05′ N. lat., and 43° 25′ W. long. In a direct line it is a little more than sixty miles from Fort Klamath. It is a small lake, not over twelve miles long by some eight or nine wide. Fresh water passes into it from Silver Creek over a swampy delta near its northwestern extremity, and a smaller stream of pure water enters it from the westward. The topography of the country about it, as well as the geology of the vicinity, is interesting, and the fauna will well repay the further investigation of the naturalist. So far as at present known, there is but one species of fish that occurs in this lake, *Mylo-leucus formosus* of Girard, one of the Cyprinidæ. Numerous species of aquatic birds are found in numbers on the lake, and frequent its limiting shores and marshes. Chief among these are the swans and geese, the pelicans and the cormorants. *Æchmophorus occidentalis*, the western grebe, represents one of the constantly present podicipidine forms found upon this sheet of water; and there they may be seen at any time of the day, either singly or in pairs. Probably, although I have no authority for it, the larger waders and several species of the limicoline birds are also to be found upon the shores of Silver Lake during the vernal and autumnal migrations.

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[1] Read before the Biological Society of Washington, March 21st, 1891.

At various distances, and in nearly all directions from it, are to be found a number of other lakes more or less like the one we have been considering, though in most instances larger than it, as in the case of Abert's Lake, found some forty-five miles to the southward and eastward.

In the Oregon desert, about forty miles east of Silver Lake, lies Fossil Lake, so named from the rich deposit of fossil mammals, birds, fish, and so forth that have been found there. This lake has long since dried up, though water may yet be obtained by digging, and that at a depth of two feet or more, anywhere over its former bottom. This latter is a perfect mine of wealth for the paleontologist, as it is absolutely filled with the fossil remains of many of the former inhabitants of, or animals that resorted to, what at one time must have been a sheet of water considerably like Silver Lake. Unfortunately for science, when the cattle men first went into that country they gathered up as objects of curiosity the majority of the best fossils of this locality, and they have thus been forever lost to us. This will account, I think, for nearly the entire absence of bird skulls among that kind of material subsequently obtained there by naturalists.

Professor Thomas Condon, of the University of Oregon, was the first scientific man that visited Fossil Lake, and he made a very carefully selected and highly valuable collection there; and some of the fossil birds found by him are now in my hands for description. A few years afterwards, Professor Cope despatched one of his assistants there, Mr. Chas. H. Sternberg, of Lawrence, Kansas, who made an enormous collection on the same ground. Later, in the '80's, Professor Cope visited the region in person, and made another fine collection, including many forms previously found by both Professor Condon and Mr. Sternberg.

In the November number, 1889, of the AMERICAN NATURALIST, Professor Cope, in an article entitled "The Silver Lake of Oregon and Its Region," to which I am indebted for the information above recited, presents us with some of the results of his eminently important researches in that country.

Setting aside the mammals and other vertebrates, it is my intention to say only a few words here about the collection of fossil birds that were obtained by the authorities mentioned.

After these latter were safely transferred east by their distinguished owner and deposited in his cabinets, he, in various scientific publications, described a number of them. They were the following species, viz.: Two forms of Podiceps, *P. occidentalis* and *P. californicus*, the first-named Professor Cope believing to be identical with the now-existing *Æchmophorus occidentalis* of that region, a species referred to above; *Podilymbus podiceps*, *Graculus macropus* s. n., *Anser hypsibatus* s. n., *canadensis*, *albifrons gambeli*, and another species near *Anser nigricans;* also a swan, which he named *Cygnus paloregonus*, and finally the fossil remains of *Fulica americana*. There were many other species still remaining, and a few years afterwards—that is, early in the present year—Professor Cope did me the honor to pass all this material into my hands for full description and illustration. Coming, as it does, just as I am about to undertake that volume of my "Osteology of the Birds of the United States" which has to deal with the water birds, now in course of preparation, this material is especially welcome to me, as the fossil forms can be conveniently compared with the existing species of birds which I shall describe in that work.

This beautiful collection of fossils consists of some fifteen hundred or more specimens of bones, many of which are perfect, many of which can be restored, and many fragmentary pieces.[2] They are all perfectly clean, the vast majority of them being of a deep leaden hue, almost black in some instances, and exhibit their characters admirably. My preliminary examination of this material leads me to believe that there are still over twenty species of fossil birds represented by it which still remain to be described. This is interesting in view of the fact that up to the present time there have been less than fifty fossil birds of the United States described by naturalists. As we all know, they constitute the rarest of all vertebrate fossil remains. So far as the birds are concerned, when the chapter is written and printed on the Equus beds of Fossil Lake, of later Tertiary times, it may prove that some of those forms still exist; others are undoubtedly extinct; while the general character of the whole agrees with forms that go to make up the existing avifauna of that region. But a close study of the departures therefrom is of the highest importance, and it is rendered the more interesting from the fact that we can compare it with the mammalian, reptilian, and icthyian faunæ of the same horizon. I find that some of these bones must have belonged to rather remarkable types of birds, and different from anything now in existence. They were all found either on or in the loose, friable deposit, the sedimentary remains of the former bottom of the lake. Furthermore, such comparative studies of this material as a whole is enhanced by the discovery of other relics found commingled with it. Of this Professor Cope has said that "Scattered everywhere in the deposit were the obsidian implements of human manufacture. Some of these were of inferior, others of superior workmanship, and many of them were covered with a patine of no great thickness, which completely replaced the natural lustre of the surface. Other specimens were as bright as when first made. The abundance of these flints was remarkable, and suggested that they had been shot at the game, both winged and otherwise, that had in former times frequented the lake. Their general absence from the soil of the surrounding region added strength to this supposition. Of course it was impossible to prove the contemporaneity of the flints with animals with whose bones they were mingled, under the circumstances of the mobility of the stratum in which they all occurred. But had they been other than human flints, no question as to their contemporaneity would have arisen. . . . . The probability of the association is, however, greatly increased by the discovery, by Mr. Wm. Taylor, of paleolithic flints in beds of corresponding age, on the San Diego Creek, Texas."[3]

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[2] The writer here exhibited some fine selected specimens from the collection, and submitted them to the members of the society present for their examination.

Should, in the future, sufficient evidence come to light to establish any such theory as this, then there will indeed be opened to us another important and interesting chapter upon the paleontologic history of man.—R. W. SHUFELDT, *Takoma Park, D. C.*

Flora of the Great Falls Coal Field, Montana.—Prof. J. S. Newberry gives an interesting account of this flora in the *American Journal of Science*, XLI., March, 1891. A number of specimens were submitted to him for examination, which he found without exception to be species described by Sir Wm. Dawson from the Kootanie Group, Canada, or by Prof. Heer from the Kome Group, Greenland. Further examination by Prof. Fontaine showed them to be also identical with fossils of the Potomac formation. This proves conclusively the general identity of the geological horizons of these four groups, and confirms the view that the Potomac group is Lower Cretaceous, and not Jurassic. A comparison with the Old World forms leads Prof. Newberry to assert that the Potomac, the Kootanie, and the Kome groups represent perhaps distinct but closely related epochs of the Neocomian or Lower Cretaceous of the Old World.

The paper closes with a brief description of the new species: *Chiropteris williamsii, Chiropteris spatulata, Zamites apertus, Baiera*

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[3] AMERICAN NATURALIST, Nov., 1889, pp. 979, 980.

brevifolia, Chadophlebis augustifolia, Sequoia acutifolia, Podzamites nervosa, and Oleandra artica Heer.

Secular Disintegration of Rocks.—In a recent paper Mr. Raphael Pumpelly insists that the recognition of the importance of secular disintegration is essential to the proper interpretation of some of the most difficult points in the study of the crystalline schists. It gives a key to the problem in the Green Mountains, N. H. He instances Iron Mountain, Mo., as a convincing illustration of a deep-reaching disintegration in pre-Silurian time, in a region which has not been folded. A mantle of disintegrated rock would be easily and quickly removed by the breaching action of the advancing sea line. "If we substitute this process in each period for the accepted one of slow erosion and breaching of hard rock, we shall," says the writer, "have to materially reconsider our time scales, in so far as they depend upon the rate of accumulation of detrital materials." (Bull. Am. Geol. Soc., Vol. II.)

The Origin of the Bahama Islands.—A careful study of the geography and geology of the Bahamas leads Dr. Northrop to declare himself in favor of a theory of elevation of these islands, instead of subsidence. The main facts that bear on the question of the most recent movement are as follows:

1. The soft calcareous mud on the west coast of Andros grows gradually harder and harder toward inland.
2. The depth of the fine calcareous deposit close to shore.
3. The extension of the pine forest.
4. Mangroves were found high above water-mark apparently dying, but none were seen in situations that indicated that the water was becoming too deep for them.

Note was taken of the extensive erosion of both the surface and the shore line of the islands. (Trans. N. Y. Acad. Sciences, Oct. 13, 1890.)

Geological News. — General. — In a recent paper on the "Resources of the Black Hills," Mr. Robert T. Hill says that this region is certainly capable of supporting a large and prosperous population. Aside from its agricultural resources and scenic beauty, it possesses bituminous coal and coke of good quality, lubricating and illuminating oil, with a possibility of natural gas, ores of precious metals, and of iron, copper, and tin. (Am. Inst. Mining Engineers, Sept., 1890.)

Paleozoic.—Prof. Alexander Winchell calls attention to some Canadian rocks in the vicinity of Echo Lake. They consist of rugged strata standing vertically, with a strike east,—a discordance of stratification with the Huronian beds, which dip at an angle of 20°, with a strike mostly northeast and southwest. He is convinced of their identity with the vertical strata in Minnesota, and the Kewatin system. Also, they are the prolongation of the "Lower Slate Conglomerate" of the Thessalon valley. (*Am. Geol.*, Dec., 1890).——Charles Proiser has examined the records of drilling in western central New York, and from these well sections has compiled a general section giving the thickness of the different geological formations, together with the total thickness of the series from the lowest Coal Measures down to the Archean. The results show that the thickness of these formations has been greatly underestimated. (*Am. Geol.*, Oct., 1890.)——Messrs. H. R. Geiger and Arthur Keith have worked out the structure of the Blue Ridge near Harper's Ferry, and refer the disputed sandstones to the Upper Silurian. (Bull. Am. Geol. Soc., Vol. II., pp. 155–164.)——The recent studies of C. Willard Hayes in the Southern Appalachians have shown a modification of the well-recognized types of *unsymmetrical fold* and the *reversed fault*, namely, broad *overthrust faults* which, as developed in Northwestern Georgia, are comparable in magnitude with those of the Scottish Highlands and the Rocky Mountains, as described by Geikie and McConnell. (Bull. Am. Geol. Soc., Vol. II., pp. 141–154).——An Ordovician chert has been found in the Llandeilo-Caradoc rocks of South Scotland, which is considered by G. J. Hinde to be due to an accumulation of the tests of Radiolaria. The beds of fine-grained red and green mudstones associated with the chert favor the view of a deep-sea origin. Mr. Hinde has described twenty-five new species from this rock, referable to fifteen genera, for the most part also new. (*Ann. and Mag. Nat. Hist.*, July, 1890.)——Mr. A. Winslow states that the flexing of the strata in the coal region of Western Arkansas is essentially Appalachian. A study of the various flexures reveals many features which call for compression and lateral movement, and this movement was from the south. The date of elevation must have been post-Carboniferous and pre-Mesozoic. (Bull. Am. Geol. Soc., Vol. II., pp. 225–242.)——According to Eugene A. Smith, the Alabama Coal Measures have an aggregate thickness of 5,525 feet. They are characterized by the small amount of sulphur, by an almost entire absence of limestone, and by having a conglomerate at the top of the series. (Alabama Geol. Survey, 1890.)——Mr. A. C. Seward agrees with Dr. Stur that Asterophyllites and Sphenophyllum are parts of the same plant. This idea was first suggested in 1853 by Newberry, who stated at that time that the difference between the wedge-shaped and filiform leaves on the same plant was due to emergence and submergence. Newberry's explanation was subsequently adopted by Colemans and Kickx. (Journ. Cin. Soc. Nat. Hist., Jan., 1891.)

Mesozoic.—Mr. Otto Lerch has made a further study of the beds between the Lower Cretacic, the Trinity sands of R. T. Hill, and the Permian, a few miles west of San Angelo, Texas, and concludes that they are pre-Cretacic and post-Permian, and probably may be the continuation and southward thinning out of the Jura and Trias. (*Am. Geol.*, Feb., 1891.)——The Report of the Yorkshire Philosophical Society, 1888, contains a description of a head of *Hybodus delabechei* from the Lower Lias of Lyme Regis, Dorsetshire, England, by A. Smith Woodward, in which he says that the teeth of the Wealden species differ so much from those of the Liassic that possibly this later Mesozoic shark may eventually prove to pertain to a distinct genus. ——In discussing the economic features of the Cretaceous rocks of Texas, Mr. R. T. Hill urges the necessity of recognizing the chalky formations of Texas as a distinct geographic region of the United States. This individuality must be recognized, and the economic development based thereon, instead of the conditions of entirely different non-chalky regions. The agricultural experience of northern and eastern states will not apply to these soils, but we must go to the chalky regions of France and England, where there are analogous formations, to learn for what they are best adapted. This region is especially rich in mineral fertilizers, and there is a great variety and abundance of building material. Owing to the slightly disturbed conditions of the formations, the district east of the Pecos is not a profitable field for the search of metallic minerals. (Report Texas Geol. Survey, 1889.)——A. Smith Woodward has figured and described two groups of teeth of the Cretaceous Selachian fish Ptychodus found in the English chalk. (Ann. Rept. Yorkshire Phil. Soc., 1889.)——Montagu Browne has revised the genus Dapedius,—a group of fossil fishes not far removed from Lepidotidæ. (Trans. Leicester Lit. and Philos. Soc., Oct., 1890.)——A study of the Shasta Group leads Mr. George Becker to conclude that the conditions and associations on the British Pacific coast appear to correspond completely with those in the United States so far as the Aucella beds are concerned, and the present indications are that all of them are to be regarded as equivalent to the Gault. (Bull. Am. Geol. Soc., Vol. II., pp. 201–208.)——The newly opened oil field of Colorado is located in the valley of the Arkansas, between Pueblo and Cañon City. At present its limits are undetermined. The bituminous shales of the Colorado group, which are evidently the source of the oil, underlie a wide belt of country along the eastern base of the Rocky Mountains. Along this zone, intermediate between the mountains and plains, oil fields will probably be found in places where the shales have been somewhat affected by the proximity of the crystalline rocks, and yet have not been too much disturbed and broken. (Prof. J. S. Newberry, *School of Mines Quart.*, Vol. X., January, 1889.)——In a recent paper, Prof. Angelo Heilprin has presented the leading facts touching the geological and paleontological relations of the Cretaceous deposits of Mexico. These deposits cover, or are scattered over, the greatest part of Mexico, from the Rio Grande to (or through) the states of Colima, Michoacan, Guerero, and Oaxaca. (Proc. Acad. Nat. Sciences, Phila., Dec., 1890.)

Cenozoic.—R. Lydekker has collected circumstantial evidence which justifies him in regarding the so-called genus Sceparnodon as based upon the upper incisors of the gigantic wombat known as Phascolonus. (Proc. Roy. Soc., Vol. 49.)——Mr. George Becker has published new evidence in favor of the authenticity of the Calaveras skull, and amply sufficient of itself to prove that man existed during the auriferous gravel period in California. He has the sworn statement of John H. Neale of the discovery of a mortar and pestle and some spear-heads, in place, in the gravel underlying the lava of Table Mountain. He also records the discovery, by Mr. Clarence King, of a polished stone implement from the same locality. The character of the tools found, which indicate a high stage of development, and their association with an extinct fauna, incline some students to discredit the discoveries. Mr. Becker suggests the reasonable hypothesis that a local glaciation of the Sierra, confined to limits later than what is known as the Glacial epoch, may be made to account for the extraordinary association of neolithic implements with Pliocene bones in California. (Bull. Am. Geol. Soc., Vol. II., pp. 189–200.)——In discussing facts bearing upon the pre-Glacial drainage of Western Pennsylvania, M. P. Foshay thinks the conclusion imperative that this area must have drained northwardly into the Erie basin. This ancient basin would then include the areas now drained by the Lower Allegheny, Clarion, Redbank, Mahoning, Conemaugh, Youghiogheny, Cheat, Monongahela, and Little Beaver rivers. (*Am. Journ. Science*, Vol. XL., Nov., 1890.)——In describing the eruption of a volcano on the island of St. Vincent, W. I., Dr. Benjamin Sharp says that the mass of material thrown out from this single vent relieved an area of the earth's crust nearly as large as that of Europe. Volcanic dust fell on an island ninety-five miles to the windward in such quantities that trees were crushed to the earth by the weight of its mass. During the eruption subterranean noises were heard at Caracas, and in the midst of the Llanos, which cover a space of 36,000 square miles. (Proc. Phila. Acad. Nat. Science, 1890.)

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—The protogine of Mont Blanc is shown by Lévy[2] to be a true eruptive, apophyses from which penetrate the surrounding schists and alter them, and break from them fragments which they hold as inclusions. These fragments have been regarded as basic segregations, and the surrounding schists have been looked upon as dynamo-metamorphosed phases of the protogine. Both of these views the author combats. Among the schists he finds eclogites, with diopside in micropegmatitic intergrowths with quartz and feldspar, amphibolites and mica-schists, each of which classes is briefly described. The segregations mentioned occur most frequently near the contact of the granite with the schists. Many of them resemble so closely certain phases of the schists that Lévy is compelled to regard them as fragments of these caught up by the eruptive during its passage from below. A microgranite from the periphery of the main mass of granite consists of corroded crystals of the first generation cemented by a granitic ground-mass. This fact is thought to be an indication of the correctness of the view that the constituents of granite are mainly of the second generation, those of the first consolidation having disappeared. To the southeast of Mont Blanc are quartz-porphyries which, according to Graeff,[3] are genetically related to the granite composing the body of the mountain. Like the latter, the porphyries have been subjected to pressure, by which process much sericite has been developed, resulting in sericite-schists. The present contact of the eruptives with the gneisses and mica-schists of the Mont Blanc "massif" is thought not to be an original contact, but one brought about by dislocations. The conclusions of Lévy and Graeff are thus seen to be in accord in some particulars, while in others they are at variance. Fuller discussions are promised later.——In the first part of a general

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Bull. des Serv. d. l. Carte. gèol. d. la France, No. 9, 1890.

[3] Archiv. des Sciences phys. et nat., Nov., 1890.